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GB2063834 A GB 2032560 A EP 0193271 A1
EP 0135082 A1

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UK CL (Edition N) **F2G G31**
INT CL[6] **F16L 21/03 37/092 37/10**

(54) Push-fit pipe coupling

(57) A push-fit pipe coupling comprises a moulded plastics body 1 defining a socket 3 to receive a pipe-retaining member 23 and/or a seal 21, the coupling body having a relaxed condition in which the socket has a internal diameter which is substantially constant or increases from its inner to its outer end, and longitudinal slots 73 such that the socket region of the body can be radially collapsed. The coupling body is moulded in its relaxed configuration with a simple core, since it does not contain inner regions of internal diameter greater than axially outer regions. While the socket is in its relaxed or expanded condition, a seal ring and/or a pipe-retaining component can be inserted into it very easily. The socket is then collapsed to a condition in which its axially outer region is of reduced diameter, thereby retaining the seal ring and/or pipe-retaining component. The coupling socket is then fixed in this collapsed condition, preferably by the application of a external metal reinforcing and retaining sleeve or cap 25. In a preferred arrangement the internal surface of the socket and the external surface of a pipe-retaining component interact as wedges, forcing the pipe retaining component into tight radial engagement with the outer surface of an inserted pipe end.

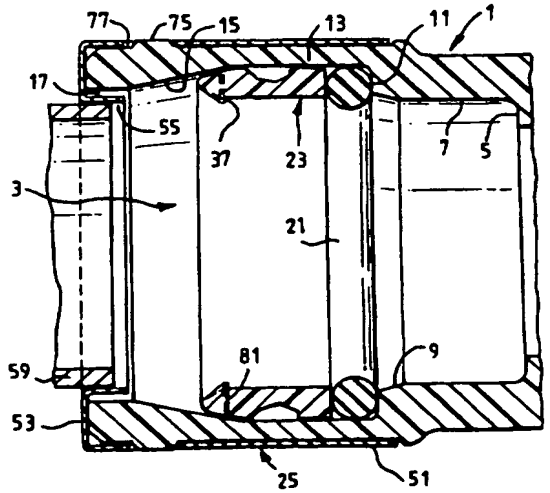

FIG.1

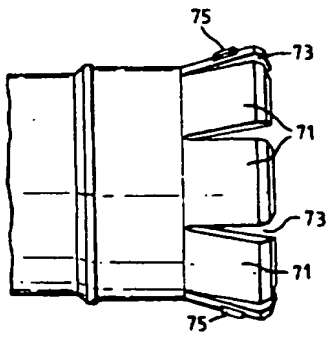

FIG.3

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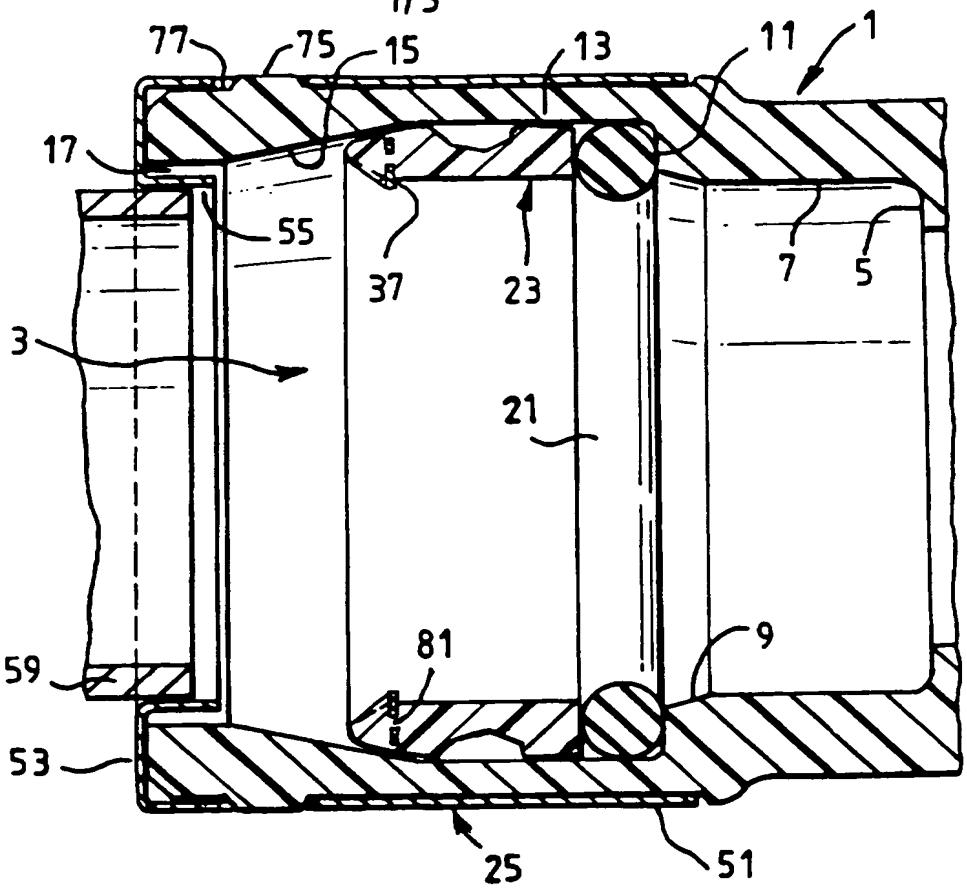

FIG.1

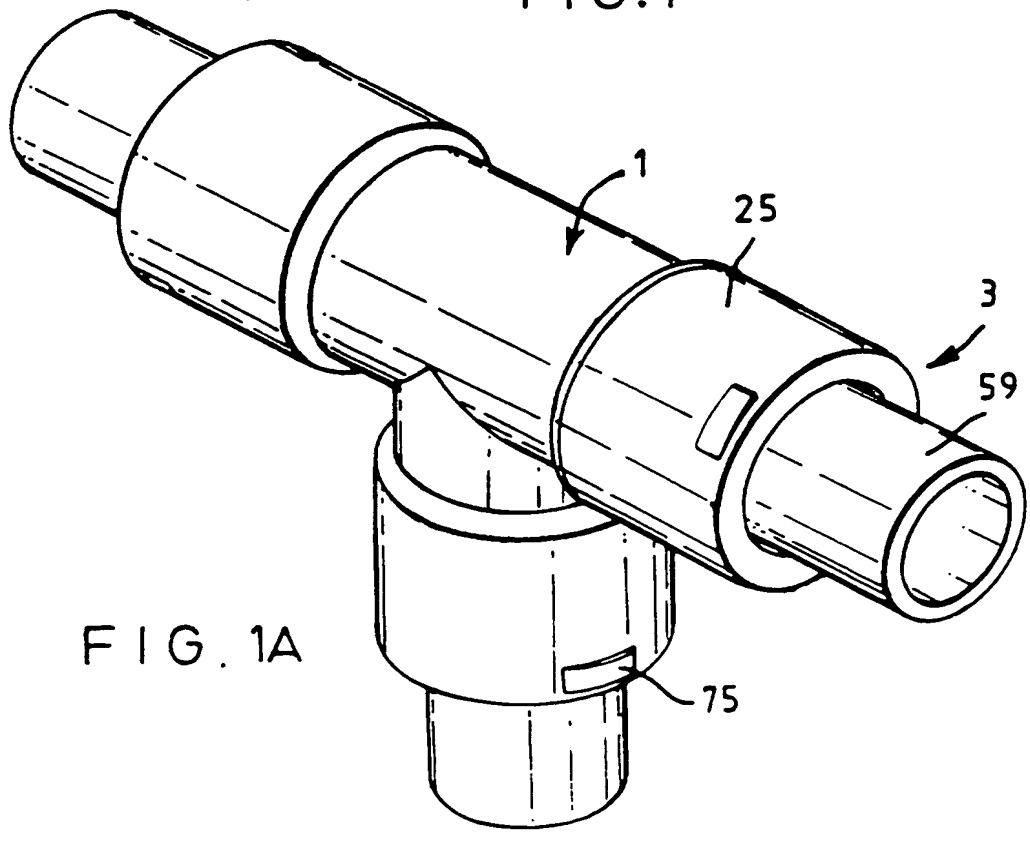

FIG. 1A

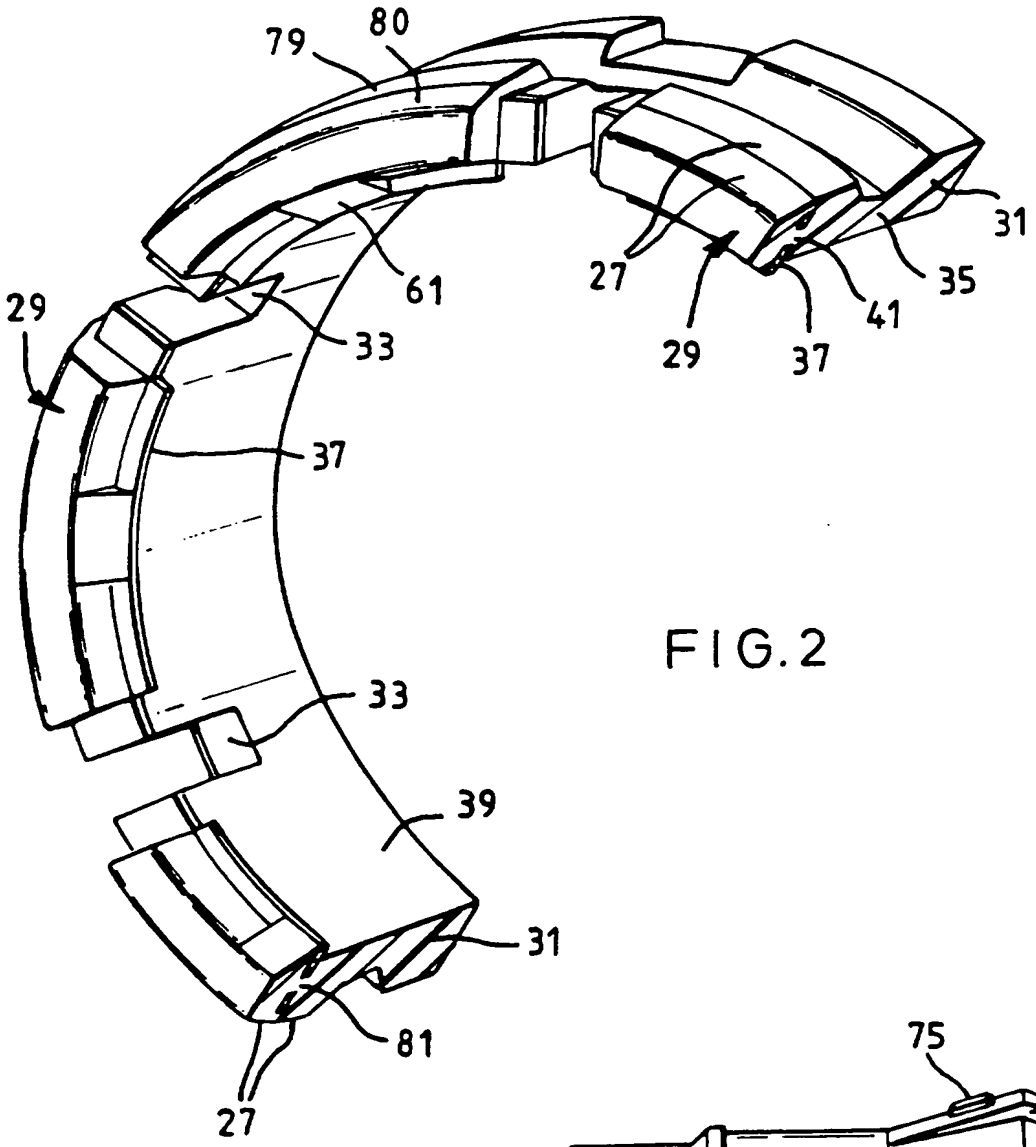

FIG.2

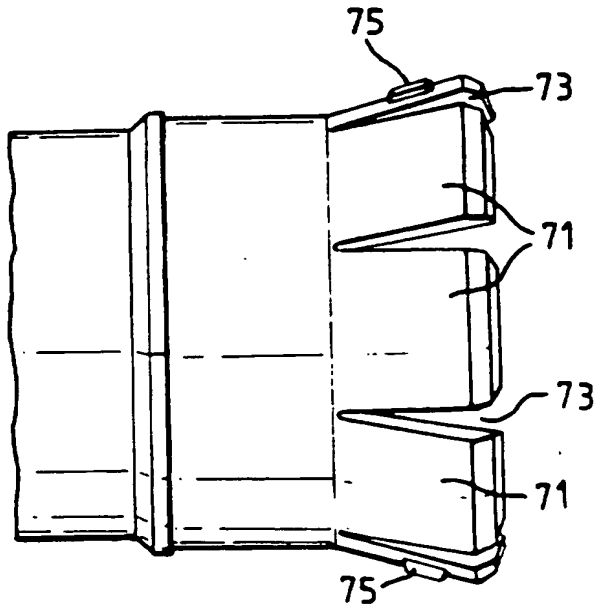

FIG.3

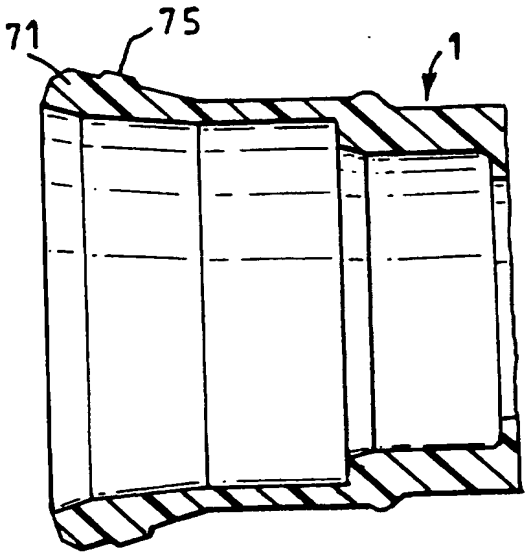

FIG. 4

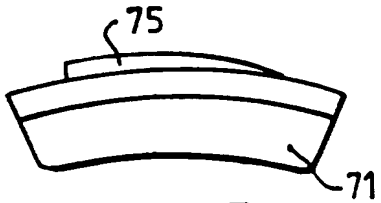

FIG. 5

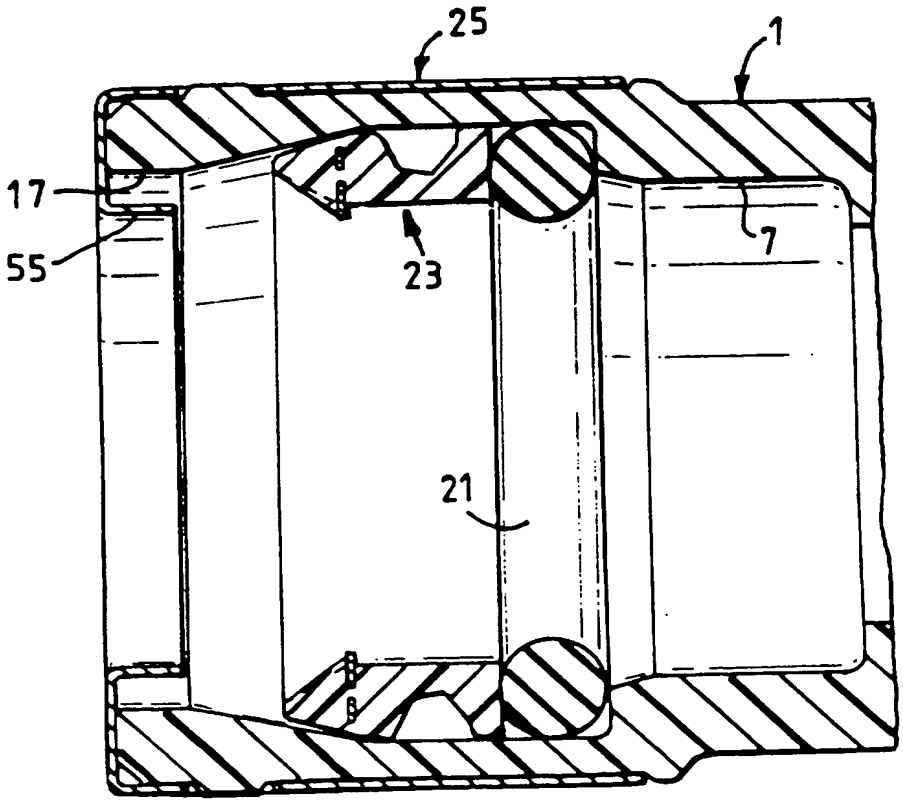

FIG. 6

PUSH-FIT PIPE COUPLINGS

This invention relates to push-fit pipe couplings.

Push-fit couplings are well known. One form is described in our British patent specification 2245945. These comprise a seal ring, and a grab ring which holds the pipe in the coupling socket. The inserted pipe end engages the O-ring seal before it engages the grab ring.

This has the disadvantage that the user, feeling the resistance of the seal to the inserted pipe end, may believe that the pipe has been fully inserted when in fact it has not engaged the grab ring. The resulting incomplete joint may not initially leak but will then fail in use.

Another form of push-fit coupling is disclosed in GB 1520742. In this, a removable collet in the coupling body grips the inserted pipe end under a wedging action exerted by the coupling body. The collet is liable to be lost. The manufacture of the coupling body with an internal wedge surface requires the use of complex moulding cores.

Push-fit pipe couplings are usually manufactured to accommodate a specific pipe diameter. A distinct range of coupling bodies has to be manufactured for each different pipe diameter. This increases manufacturing costs, and inventory costs for suppliers and users.

An object of the present invention is to provide push-fit pipe couplings capable of being easily manufactured and assembled, and capable of accommodating pipes of different diameters using a common coupling body.

According to one aspect of the present invention, a push-fit pipe coupling comprises a moulded plastics body defining a socket adapted to receive a pipe-retaining member and/or a seal, the coupling body having an as-moulded relaxed condition in which the said socket has an internal diameter which is substantially constant or increases from its inner to its outer end, and at least one longitudinal slot in the socket region such that the said region of the body can be radially collapsed after moulding to a condition in which the internal diameter of the socket is less in an axially outward region of the socket than it is an axially inner region of the socket; restraining means being provided on the socket region of the coupling body for maintaining it in the collapsed condition.

With such a construction, the coupling body is moulded in its relaxed configuration, and it will be understood that the socket can then be moulded with a simple core, since it does not contain inner regions of internal diameter greater (or significantly greater) than axially outer regions. In particular, it is not necessary to use collapsible cores. Furthermore, while the socket is in its relaxed or expanded condition, a seal ring and/or a pipe-retaining component can be inserted into it very easily. It is not necessary to make either of these components (in particular the pipe-retaining component) collapsible to permit insertion into the socket. The socket is then collapsed to a condition in which its axially outer region is of reduced diameter, thereby retaining the seal ring and/or pipe-retaining component. The coupling socket is then fixed in this collapsed condition, in any convenient way, preferably by the application of an external metal reinforcing and retaining sleeve or cap.

In a preferred arrangement, the internal surface of the socket and the external surface of a pipe-retaining component are frusto-conical so as to interact as wedges, thereby in use forcing the pipe retaining component into tight radial engagement with the outer surface of an inserted pipe end, when under axial tension.

Preferably, the pipe retaining component is a moulded plastics ring or collet with embedded metal teeth for engaging the pipe surface.

Pipe couplings embodying the invention are preferably so designed as to form part of a coupling system comprising coupling sockets of a single size common to a variety of pipe diameters, and a plurality of pipe retaining components adapted respectively to fit the ends of pipes of different diameters, and to be accommodated in one and the same single size of coupling socket.

A push-fit pipe coupling embodying the invention will be described with reference to the accompanying drawings, in which:

Fig. 1 is an axial cross section of a socket region of a push-fit pipe coupling;
Fig. 1A is a perspective view of a T-piece coupling;
Fig. 2 is an enlarged cut-away view of a retaining ring of the coupling of Fig. 1;
Fig. 3 and 4 are side and sectional views of the coupling socket region as moulded;
Fig. 5 is an end view of a detail of the socket region; and
Fig. 6 shows a second pipe coupling.

Figure 1 is an axial cross section through a socket region 3 of a pipe coupling embodying the invention. The pipe coupling has a moulded plastics body 1. It will be understood that figure 1 shows only a portion of the moulded plastics body. A complete pipe coupling may comprise an integral T-piece body having three socket regions as shown in figure 1, or the body may have any conventional pipe fitting form for example a through connection, a Y, a bend, a valve body, and so on. It may therefore have one or more coupling sockets 3 each as illustrated in figure 1. By way of example only, Fig. 1A shows a complete T-piece coupling.

The socket has, at its axially inner end, a transverse abutment 5, which defines the position of maximum insertion of a pipe end to be coupled. In the completed condition of the coupling shown in figure 1, the socket comprises the following regions, considered axially outwardly from the abutment 5: cylindrical region 7; flared transition region 9; radial abutment or shoulder 11 of increased diameter; cylindrical region 13 of increased diameter; convergent frusto-conical wedge region 15; cylindrical mouth region 17.

Within the regions 11, 13, 15 are accommodated a conventional O-ring seal 21 and a pipe-retaining ring 23.

A metal retaining cap 25 is fitted over the outside of the coupling body, extending at least over the regions 11-17 of the socket and fitting closely about the external surface of the body.

The pipe retaining component 23 is a moulded plastics ring with an external diameter greater than the diameter of the mouth 17 so as to be retained in the socket. The seal ring 21 is located between the retaining ring 23 and the socket abutment 11.

The retaining ring 23 is shown in enlarged partial section in figure 2. Its axially outer region has an external frusto-conical wedge surface 27 which coacts with the internal wedge surface 15 of the socket. This wedge surface 27 is provided on a plurality of segments 29 each integral with a circumferentially continuous ring or shoulder region 31 and divided from each other by radial slots 33. As a result, each segment 29 can flex radially independently of the other segments and of the continuous shoulder region 31. To enhance this flexibility, an annular region 35 of reduced radial thickness is provided between each segment 29 and the shoulder region 31. The slots 33 extend at least partly into this region 35 of reduced thickness. Each segment 29 can be regarded as a respective finger of a collet.

Wedge surface 27 has two different angles The axially inward part 79 provides the clamping action and the outward or front part 80 is effectively a clearance angle to prevent the front edge of the wedge digging in to the socket wedge surface 15 and stopping the movement of the wedge ring 23.

The regions 29, 31, 35 form a single integral moulded plastics body. Embedded in this, for example by insert moulding, are a plurality of arcuate gripping members or teeth 37, made for example of metal. These project radially inwardly from the internal surface 39 of the retaining ring, which in its

relaxed condition is cylindrical. Radially outwardly, the metal members 37 terminate within the thickness of the retaining ring, radially within the wedge surface region 27. Apertures 41 initially provided in the metal members 37 are filled with the moulded plastics material of the retaining ring for fixing the metal members positively in the ring body.

The internal diameter of the retaining ring surface 39 corresponds to the external diameter of a pipe to be coupled. The internal diameter of the arcuate inner edges of teeth 37 is slightly less than the diameter of the pipe.

The metal cap 25 consists of a cylindrical skirt 51 which fits closely over the coupling body in the socket region; a radially inwardly bent end flange 53 overlying the outer end of the coupling body adjacent the socket mouth 17, and an axially inwardly bent mouth 55 projecting into the socket mouth 17. The mouth 55 has an internal diameter corresponding to the external diameter of pipes to be coupled.

In use, a pipe end 59 is inserted into the socket through the mouth 55 and is pushed past the teeth 37, through the retaining ring 23 and the seal ring 21, into the socket region 7 until it abuts the radial abutment 5. The user can feel when the pipe end touches the abutment 5 so that the user then knows that the pipe has been fully inserted in the socket.

However, provided that the pipe end has been inserted past the seal ring 21, it will be adequately retained and sealed and the joint will function perfectly. If, inadvertently, the pipe end is not inserted past the seal ring, the joint will leak

when tested, showing it to be defective. It will not however fail catastrophically by expulsion of the pipe, because the pipe will nevertheless be gripped by the retaining ring 23, since the latter is axially outside the seal ring and is therefore the first component encountered by the inserted pipe end.

As the inserted pipe end passes the metal teeth 37, these grip it frictionally, but of course not tightly enough to impede further insertion of the pipe end. At this stage, the inserted pipe end urges the wedge surface 27 of the retaining ring away from the wedge surface 15 of the socket.

Subsequently, if the inserted pipe end is urged axially outwards from the socket, its initial axial movement will cause the teeth 37 and the retaining ring 23 to move axially outwards with it. This brings the wedge surfaces 15, 27 into interaction. The convergent wedge surface 15 then presses the wedge surface 27 radially inwards as the retaining ring 23 moves axially outwards, causing the teeth 37 to bite firmly into the external surface of the pipe. The individual segments 29 of the retaining ring flex independently about the thinner region 35 during this wedging and pipe-gripping action.

The retaining ring 23 may be provided, at its axially outer end, with small internal convergent guide surfaces 61, leading up to the inner edges of the teeth 37, so as to ensure that the inserted pipe end is accurately centred relative to and is guided past the teeth 37.

In cross section, the teeth 37 lie strictly radially. This enables them to be insert moulded using a flat piece or pieces of metal or flat metal strip. By way of

example only, the teeth 37 may initially comprise arcuate regions of a common flat metal plate or strip,arranged around a central aperture corresponding to the bore of the retaining ring 23. The material of the latter is moulded onto the metal around the aperture, the plate having slots to enable the plastics material of the ring to flow around and through it as can be seen at position 81. After moulding the metal plate is cropped at the slots 33 so as to leave only the regions constituting the teeth 37, embedded in the retaining ring.

Figures 3 and 4 show a side view and axial section of the socket region of the body, in the as-moulded state before assembly with the other components of the socket. As best shown in figure 3, the axially outer region of the body, constituting in use the wedge surface 15 and mouth 17, is moulded as a plurality of fingers 71 separated by slots 73 extending axially inwardly from the mouth of the socket. As can be seen in figure 4, in the as-moulded condition the radially-inner surfaces of the fingers 71, which in use form the surfaces 15, 17 of the socket, are outwardly flared or divergent, towards the socket mouth, whereas in the completed socket the wedge surface 15 converges towards the socket mouth. The socket as moulded has no portion of which the internal diameter is greater than any portion axially exterior to it. As a result, the socket can be moulded using a simple one-piece core, instead of a collapsible core which would be required to produce a solid socket of the internal profile shown in figure 1.

The as-moulded socket profile shown in figure 4 has the further advantage that the components 21, 23 can be inserted into it very easily, without deformation of either component or of the socket. After the components 21, 23 have been

inserted, the cap 25 is fitted over the exterior of the fingers 71 and the rest of the socket, the fingers 71 being pressed radially inwards in any convenient way to allow this. In consequence the socket adopts the profile in figure 1 and is held in this configuration by the metal cap 25. It will be understood that the cap 25 also provides mechanical reinforcement of the socket, resisting hoop stresses which will arise when the wedge surface 27 of the retaining ring 23 is forced into contact with the socket wedge surface 15, and in use due to the compression of the rubber seal and the internal water pressure behind the seal.

The cap 25 is held on the socket by friction, mechanical interaction, adhesive, or in any other convenient way. Preferably, one or more retaining projections 75 on the external surface of the coupling body engage corresponding apertures 77 in the external skirt 51. The cap is forced over the projections 75 until these register with the apertures 77 and the projections 75 then snap into the apertures 77 by virtue of the natural resilience of the fingers 71 urging these radially outwards towards the as-moulded position. Preferably, each projection 75 forms a circumferentially extending ramp as shown in figure 5, with all the ramps extending in the same circumferential direction. The advantage of this is that the cap can be removed subsequently, by rotating it relative to the coupling body in such a direction as to ride up the ramps of the projections 75, enabling the apertures 77 to be rotated until they are clear of the projections 75, and the cap can then be pulled off the coupling body. This allows the fingers 71 of the coupling body to expand outwards, so that the seal ring 21 and/or retaining ring 23 can be removed or replaced.

It will be seen that the interacting wedge regions of the retaining ring 23 and the coupling body both consist of flexible fingers separated by axial slots. To avoid undesirable interaction or interlocking between them, the number of fingers on the retaining ring is preferably different from the number of fingers of the coupling body.

The described coupling can be made of any suitable materials. By way of example only, the coupling body can be made of polybutylene or cross linked polyethylene. The retaining ring 23 can be made of nylon or PVDF. The teeth 37 and cap 25 are preferably made of stainless steel.

The described coupling is particularly suitable for jointing plastics pipes, in particular plastics water supply pipes, but can also be used for jointing pipes of other materials, for example copper pipes.

The described coupling has a number of significant practical advantages as regards its manufacture and its use, some of which have already been described. As already noted, the seal is further inside the socket than is the retaining ring, which avoids catastrophic failure if the joint is incorrectly assembled. A further advantage of the arrangement is that, because the retaining ring is of completely solid and circumferential continuous cross section at its axially inner side (being slotted only at its axially outer side), its shoulder region 31 provides a very strong, rigid outer abutment or retainer for the seal ring. Because this part of the retaining this is undivided, it is not necessary to provide any washer or other support between the seal ring and the retaining ring. The seal ring is supported directly by the retaining ring. This makes assembly easier and cheaper.

The described coupling is preferably used as an element of a coupling system , in which coupling bodies of a single size are fitted with seal rings, retaining rings, and reinforcing caps of different internal diameters but a common external diameter, for accommodating pipes of different external diameter. For example, a common coupling body (or range of couplings bodies) can be used to accommodate 15mm and 16mm pipes, using components 21, 23, 25 of different internal diameters. The socket regions 7 of the coupling body would then have an internal diameter corresponding to the external diameter of the largest pipe to be accommodated (for example 16mm). The mouth region 17 of the coupling body is somewhat over-sized for the largest pipe. The common coupling body is fitted with components 21, 23, 25 of internal diameter 15mm or 16mm, to provide in effect two ranges of couplings, for accommodating imperial or metric equivalent diameter pipes. Similarly, common coupling bodies and different seal ring, retaining ring and reinforcing cap components can be used for pipe diameter pairs 20/22mm, 25/28mm, 10/12mm. This is illustrated by figure 6, which shows a coupling body identical to that shown in figure 1, but with the seal ring, retaining ring and reinforcing cap of smaller internal diameters. In this case the inserted pipe end is supported radially only by the internal skirt 55 of the reinforcing cap, and the internal surface of the retaining ring 23, not by the socket surface 7. In the case of Fig. 1 the pipe is supported radially by the surface 7, the skirt 55, and the internal surface of the retaining ring.

Thus, to cope with pipes of slightly different diameter, the manufacturer, stockist and user need only deal with one size of coupling body, with suitable added components, thereby reducing cost, in particular manufacturing tooling cost because the number of body-moulding tools (which are costly) is reduced.

The described coupling uses a retaining ring with embedded metal teeth for gripping the pipe. Alternatively, a wedge-section plastics or metal retaining ring may have integral teeth, particularly for softer pipe materials, or may grip the pipe essentially frictionally.

The described coupling has a wedge-action retaining ring. However, this is not essential. A toothed grab ring as shown for example in GB 2245945 can be used. The provision of an axially slit coupling body with an expended as-moulded state is advantageous for use with all forms of retaining ring, because it facilitates the moulding of the socket and the insertion of the retaining ring, as already described. Therefore, the invention is also applicable to a coupling in which the socket has towards its outer end a transverse abutment or shoulder engaging a retaining ring, as well as to couplings using a wedge-action socket and retaining ring as described.

CLAIMS

1. A push-fit pipe coupling which comprises a moulded plastics body defining a socket adapted to receive a pipe end, the coupling body having an as-moulded relaxed condition in which the said socket has an internal diameter which is substantially constant or increases from its inner to its outer end, and at least one longitudinal slot in the socket region such that the said region of the body can be radially collapsed after moulding to a condition in which the internal diameter of the socket is less in an axially outward region of the socket than it is in an axially inner region of the socket; restraining means provided on the socket region of the coupling body for maintaining it in the collapsed condition; and a pipe-retaining member and/or seal in the socket.

2. A coupling according to claim 1 in which the internal surface of the socket and the external surface of the pipe-retaining member are tapered so as to interact as wedges, thereby in use forcing the pipe retaining member into tight radial engagement with the outer surface of an inserted pipe end, when under axial tension.

4. A coupling according to claim 2 or 3 in which the pipe-retaining member is a moulded plastics ring or collet with embedded metal teeth for engaging the pipe surface.

3. A coupling according to claim 2 in which the pipe-retaining member comprises a circumferentially continuous axially inner region adjacent a seal ring in the socket and integral with radially flexible fingers divided by longitudinal gaps, in an axially outer region of the member, said fingers having tapered external surfaces for wedging interaction with the tapered internal surface of the socket.

5. A coupling according to claim 4 in which regions of reduced thickness are provided between the fingers and the circumferentially continuous inner region of the pipe-retaining member.

6. A coupling according to claim 4 or 5 in which the number of fingers is different from the number of slots provided in the socket region of the body.

7. A coupling according to any of claims 3 to 6 in which the embedded metal teeth are flat and extend radially in cross section.

8. A coupling according to any of claims 3 to 7 in which the pipe-retaining member includes localised guide surfaces for guiding an inserted pipe end into centred relationship with the teeth.

9. A pipe coupling according to any of claims 1 to 8 in which the restraining means is a sleeve-like member encircling the socket region.

10. A coupling according to claim 9 in which the restraining means is mechanically retained on the coupling body in releasable manner.

11. A coupling according to claim 10 in which the restraining means is mechanically retained on the socket region by inter-engaging radial projections and apertures of the restraining means and coupling body, shaped to facilitate disengagement by relative rotation of the restraining means and body.

12. A coupling as claimed in any of claims 9 to 12 in which the restraining means further comprises an inwardly extending region at its axially outer end, and a flange forming a mouth extending axially from said region into the mouth of the socket for guiding and radially locating an inserted pipe end.

13. A method of making a push-fit coupling of the kind comprising a pipe-retaining member and/or a seal retained in a socket in a coupling body, comprising:

moulding a plastics body in a form comprising a socket region having at least one longitudinal slot in the wall thereof, with the socket having an internal profile of which the internal diameter is substantially constant or increases from its inner to its outer end; inserting into the moulded socket a pipe-retaining member and/or a seal; radially collapsing the socket region to a condition in which the internal diameter of the socket is less in an axially outward region of the socket than it is in an axially inner region of the socket; and restraining the socket region thereby maintaining it in the said collapsed condition whereby the pipe-retaining member and/or seal are retained in the socket.

14. A method as claimed in claim 13 in which, for maintaining the socket region in the collapsed condition, a peripheral restraining sleeve is fitted over it.

15. A push-fit pipe coupling substantially as herein described with reference to the accompanying drawings.

16. A method of making a push-fit pipe coupling, substantially as herein described with reference to the accompanying drawings.

16

Patents Act 1977 **Examiner's report to the Comptroller under Section 17** **(The Search report)**	Application number GB 9517475.1
Relevant Technical Fields (i) UK Cl (Ed.N) F2G (G31) (ii) Int Cl (Ed.6) F16L 21/03, 37/092, 37/10	Search Examiner MR M SIDDIQUE Date of completion of Search 15 NOVEMBER 1995
Databases (see below) (i) UK Patent Office collections of GB, EP, WO and US patent specifications. (ii)	Documents considered relevant following a search in respect of Claims :- 1-16

Categories of documents

X:	Document indicating lack of novelty or of inventive step.	**P:**	Document published on or after the declared priority date but before the filing date of the present application.
Y:	Document indicating lack of inventive step if combined with one or more other documents of the same category.	**E:**	Patent document published on or after, but with priority date earlier than, the filing date of the present application.
A:	Document indicating technological background and/or state of the art.	**&:**	Member of the same patent family; corresponding document.

Category	Identity of document and relevant passages		Relevant to claim(s)
X	GB 2063834 A	(BOC LIMITED) radially collapsible socket with longitudinal slots, restraining ring 11 and a sealing element, see Figures and page 3, lines 127-130 etc	1, 13 at least
X	GB 2032560 A	(INDUSTRIES NEOPLAST) see page 1, lines 93-104, 114-118 etc	1, 13 at least
A	EP 0193271 A1	(AEROQUIP)	1, 13
X	EP 0135082 A1	(SOCIEDAD...) see Figures 1, 2 etc; expanded state of socket 2 in Figure 1 and collapsed state thereof in Figure 2 with restraining device 9	1, 13 at least

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